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(71) Applicant:

**SOCIETE DES PRODUITS NESTLE S.A.  
1800 Vevey (CH)**

(72) Inventors:

- **Jury, Mark**  
Thirsk, North Yorkshire YO7 2PH (GB)
- **Mackley, Malcolm Robert**  
Crescent, Cambridge CB4 1AP (GB)
- **Crook, Simon John**  
Exeter, Devon EX4 4AF (GB)

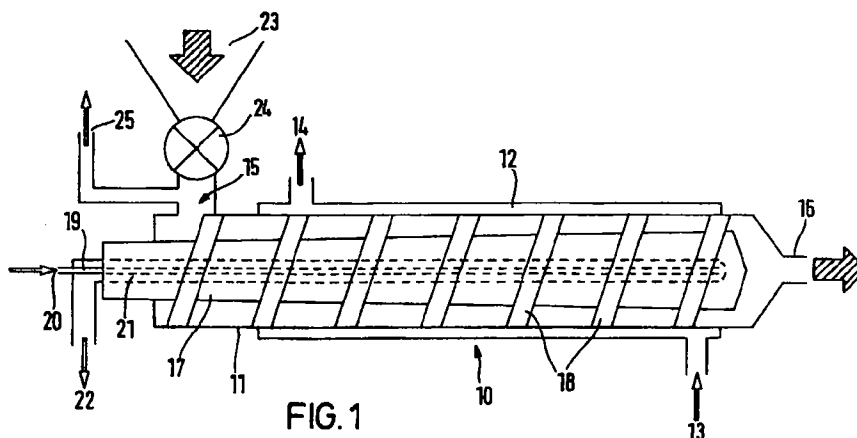
(74) Representative:

**Pate, Frederick George et al**  
55, Avenue Nestlé  
1800 Vevey (CH)

**(54) Extrusion of chocolate**

(57) A process for plastically extruding a fat-containing confectionery material which comprises feeding the fat containing confectionery material into an extruder and applying pressure to the fat-containing confectionery material in a substantially solid or semi-solid non-pourable form upstream of a flow constriction whereby the temperature, pressure, contraction ratio and extrusion rate are such that the fat-containing confectionery material is extruded and remains in a substantially solid or semi-solid nonpourable form to produce an axially

homogeneous extruded product having a cross section that is of substantially the same profile as the die exit of the extruder, which is capable of retaining its shape and which has a temporary flexibility or plasticity enabling it to be physically manipulated, cut or plastically deformed before losing its flexibility or plasticity characterised in that a vacuum is applied to the fat-containing confectionery material upstream of the flow constriction.



**FIG. 1**

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## Description

The present invention relates to the extrusion of chocolate and more particularly to a process for the extrusion of solid or semi-solid chocolate.

In our co-pending EP-A-93114251.7, the entirety of which is hereby incorporated by reference, we describe a process for plastically extruding a fat-containing confectionery material which comprises feeding the fat containing confectionery material into an extruder and applying pressure to the fat-containing confectionery material in a substantially solid or semi-solid nonpourable form upstream of a flow constriction whereby the temperature, pressure, contraction ratio and extrusion rate are such that the fat-containing confectionery material is extruded and remains in a substantially solid or semi-solid nonpourable form to produce an axially homogeneous extruded product having a cross section that is of substantially the same profile as the die exit of the extruder, which is capable of retaining its shape and which has a temporary flexibility or plasticity enabling it to be physically manipulated, cut or plastically deformed before losing its flexibility or plasticity.

In GB-A-96 06285, the entirety of which is hereby incorporated by reference, we describe a process for the continuous extrusion of chocolate or a fat-containing confectionery material using a screw extruder which comprises feeding the chocolate or fat-containing confectionery material into the screw extruder and generating a pressure to force the chocolate or fat-containing confectionery material in a substantially solid or semi-solid nonpourable form upstream of a flow constriction whereby the temperature of the screw, the temperature of the barrel wall, the screw speed, pressure, contraction ratio and extrusion rate are such that the chocolate or fat-containing confectionery material is extruded in a substantially solid or semi-solid nonpourable form to produce an axially homogeneous extruded product having a cross section that is of substantially the same profile as the die exit of the extruder, which is capable of retaining its shape and which has a temporary flexibility or plasticity enabling it to be physically manipulated, cut or plastically deformed before losing its flexibility or plasticity.

The temporary flexibility of the extruded fat-containing confectionery material obtained in the process of the above-mentioned co-pending patent application may last for up to 4 hours or more, generally from 0.1 second to 2 hours or typically from 10 seconds to 1 hour. During this period of temporary flexibility, the extruded fat-containing confectionery material may be cut cleanly and this is in contrast to fat-containing confectionery material extruded by a process as described either in EP-A-93114251.7 or in GB-A-96 06285 after the temporary flexibility has been lost, or to a normal set chocolate which has to be heated slightly for cutting otherwise it would shatter owing to its brittleness. However, the appearance of the chocolate is not always as attractive

as desired because there may be whitish streaks or blotches on both the exterior surface and on the cut surface. The streaks or blotches give a streaky pattern similar to mouldy cheese.

Surprisingly, we have found that by applying a vacuum to the chocolate feed upstream of the extruder die, the extruded chocolate has an attractive appearance without or substantially without any streaks or blotches on either the exterior surface or on the cut surface. Although not wishing to be bound by any theory, we believe that the product cohesiveness is improved owing to a reduction of the trapped air spaces in the product.

Accordingly, the present invention provides a process for plastically extruding a fat-containing confectionery material which comprises feeding the fat containing confectionery material into an extruder and applying pressure to the fat-containing confectionery material in a substantially solid or semi-solid nonpourable form upstream of a flow constriction whereby the temperature, pressure, contraction ratio and extrusion rate are such that the fat-containing confectionery material is extruded and remains in a substantially solid or semi-solid nonpourable form to produce an axially homogeneous extruded product having a cross section that is of substantially the same profile as the die exit of the extruder, which is capable of retaining its shape and which has a temporary flexibility or plasticity enabling it to be physically manipulated, cut or plastically deformed before losing its flexibility or plasticity characterised in that a vacuum is applied to the fat-containing confectionery material upstream of the flow constriction.

Before being fed into the extruder, the fat containing confectionery material may be stored in a hopper or other container. The vacuum may be applied to the fat containing confectionery material at any point between the hopper and the infeed of the extruder or while the fat-containing confectionery material is being fed into the extruder. Optionally, a valve, preferably a rotary valve, may be present between the hopper or other container and the infeed of the extruder. The vacuum pressure may be as low as 1mbar or less but is more conveniently from 10 to 500mbar and preferably from 50 to 300 mbar.

The fat containing confectionery material may be fed into the barrel of the extruder in a solid or semi-solid form, e.g. in a granular or continuous form. When in granular form, the granular nature of the fat containing confectionery material appears to be lost during extrusion to give an essentially uniform material. The extruded material can be cut cleanly during the post-extrusion period of temporary flexibility or plasticity.

The extruder may be a ram extruder, a single screw extruder, a twin screw extruder or a Conform machine. The twin screw extruder may have either counter-rotating screws or co-rotating screws. The process may be continuous when a screw extruder is used.

When a screw extruder is used, the conditions of

the screw extrusion may be as described in GB-A-96 06285.

The chocolate material may be dark, milk or white chocolate. Fat containing confectionery materials may include sugar, milk derived components, and fat and solids from vegetable or cocoa sources in differing proportions having a moisture content less than 10%, more usually less than 5% by weight. They may be chocolate substitutes containing direct cocoa butter replacements, stearines, coconut oil, palm oil, butter or any mixture thereof; nut pastes such as peanut butter and fat; praline; confectioner's coatings used for covering cakes usually comprising chocolate analogues with cocoa butter replaced by a cheaper non-tempering fat; or "Caramac" sold by Nestlé comprising non-cocoa butter fats, sugar and milk.

If desired, two or more fat-based confectionery materials may be extruded in accordance with the process of the present invention. In addition, the chocolate or fat-containing confectionery material may be co-extruded with other food materials such as ice cream, sorbet, yoghurt, mousse, fondant, praline, marshmallow, nougat or jelly, etc., such being advantageous when the fat-containing confectionery material is extruded in a hollow or tubular form. Hence, in such embodiments, a multi-orifice die and/or associated equipment, as are known to those skilled in the art, may be employed.

The temperature of the chocolate or fat-containing confectionery material as it is extruded may conveniently be from 0° to 28°C, more usually from 15 to 25°C, e.g. from 18° to 23°C.

The present invention will now be further described by way of example only with reference to the accompanying drawing in which Figure 1 represents a schematic diagram of a continuous extrusion system.

Referring to Figure 1, the extruder generally designated 10 comprises a barrel 11 provided with a cooling jacket 12 having an inlet for cooling fluid 13 and an outlet for cooling fluid 14, an inlet for the feed material to be extruded 15, a die 16 having a circular cross-section and a diameter of 6.5mm, and a screw 17 whose root diameter increases from the upstream end to the downstream end and provided with threads 18 whose pitch is constant from the upstream end to the downstream end. The screw 17 is provided with a channel 19 for heating fluid extending from the upstream end to the downstream end having an inlet 20 connected with a concentric channel 21 leading to an outlet for the heating fluid 22. Positioned above the inlet for the feed material to be extruded 15 is a hopper 23, a rotary valve 24 and a connecting pipe 25 leading to a means for applying a vacuum 25 (not shown).

The operation of the above described single screw extruder will now be described in the following Examples.

#### Example 1

Milk chocolate buttons in the hopper 23 having a temperature of 22°C are fed via the rotary valve 24 into the barrel 11 of the extruder 10 through the feed inlet 15. Positioned between the rotary valve 24 and the feed inlet 15 is a pipe 25 leading to a vacuum pump (not shown) which applies a vacuum pressure of 100mbar to the chocolate buttons. The screw 17 has a diameter of 32mm, a length to diameter ratio of 24:1, a 2:1 compression ratio and a screw speed of 65rpm. A 50:50 mixture of water and glycol at -5°C flows through the cooling jacket 12 of the barrel and water at 20°C flows through the channels 19 and 21 of the screw. As the screw rotates, the solid chocolate flows through at a rate of 15kg/hr and is extruded through the die 16 with a configuration conforming to that of the die and has a temporary flexibility which lasts for about 1 hour. The extruded chocolate is cut 1 minute after extrusion and exhibits no streaks or blotches on its exterior or cut surfaces.

#### Example 2

Milk chocolate buttons in the hopper 23 having a temperature of 22°C are fed via the rotary valve 24 into the barrel 11 of the extruder 10 through the feed inlet 15. Positioned between the rotary valve 24 and the feed inlet 15 is a pipe 25 leading to a vacuum pump (not shown) which applies a vacuum pressure of 100mbar to the chocolate buttons. The screw 17 has a diameter of 90mm, a length to diameter ratio of 15:1, a 2:1 compression ratio and a screw speed of 35rpm. Water at 5°C flows through the cooling jacket 12 of the barrel and water at 20°C flows through the channels 19 and 21 of the screw. As the screw rotates, the solid chocolate flows through at a rate of 280kg/hr and is extruded through the die 16 with a configuration conforming to that of the die and has a temporary flexibility which lasts for about 1 hour. The extruded chocolate is cut within 1 second after extrusion and exhibits no streaks or blotches on its exterior or cut surfaces.

#### Claims

1. A process for plastically extruding a fat-containing confectionery material which comprises feeding the fat containing confectionery material into an extruder and applying pressure to the fat-containing confectionery material in a substantially solid or semi-solid nonpourable form upstream of a flow constriction whereby the temperature, pressure, contraction ratio and extrusion rate are such that the fat-containing confectionery material is extruded and remains in a substantially solid or semi-solid nonpourable form to produce an axially homogeneous extruded product having a cross section that is of substantially the same profile as the die exit of the extruder, which is capable of

retaining its shape and which has a temporary flexibility or plasticity enabling it to be physically manipulated, cut or plastically deformed before losing its flexibility or plasticity characterised in that a vacuum is applied to the fat-containing confectionery material upstream of the flow constriction. 5

2. A process according to claim 1 wherein before being fed into the extruder, the fat containing confectionery material may be stored in a hopper or other container and the vacuum is applied to the fat containing confectionery material either at any point between the hopper and the infeed of the extruder or while the fat-containing confectionery material is being fed into the extruder. 10 15
3. A process according to claim 2 wherein a valve is present between the hopper or other container and the infeed of the extruder. 20
4. A process according to claim 3 wherein the valve is a rotary valve.
5. A process according to claim 1 wherein the vacuum pressure is from 10 to 500mbar. 25
6. A process according to claim 1 wherein the extruder is a ram extruder, a single screw extruder, a twin screw extruder or a Conform machine. 30
7. A process according to claim 1 wherein the chocolate or fat-containing confectionery material may be co-extruded with another chocolate or fat-based confectionery material or another food material. 35
8. A process according to claim 7 wherein the other food material is ice cream, sorbet, yoghurt, mousse, fondant, praline, marshmallow, nougat, jelly or any other food material. 40
9. An extruded fat-containing confectionery material obtainable by a process according to any of the preceding claims. 45

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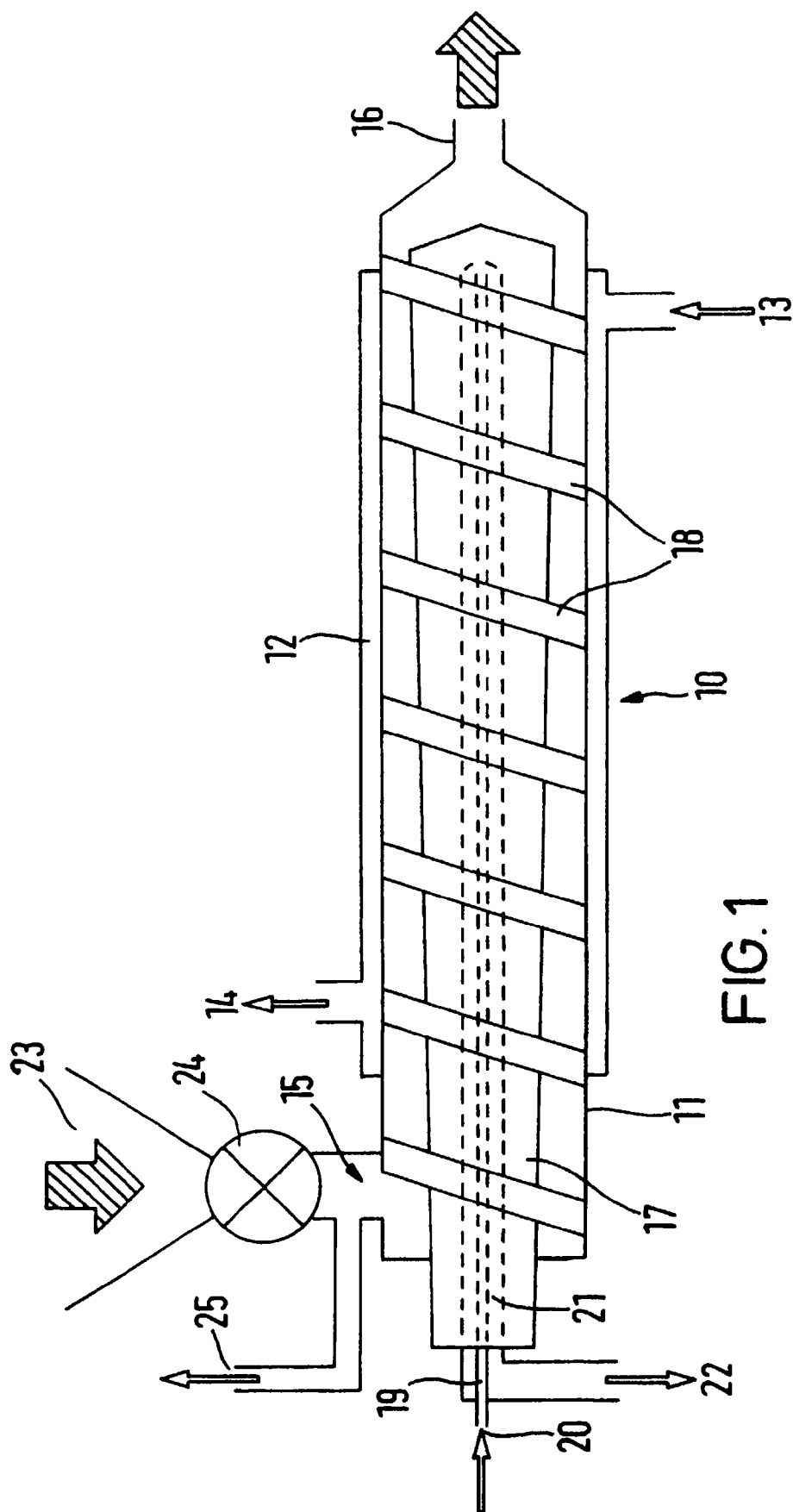


FIG. 1



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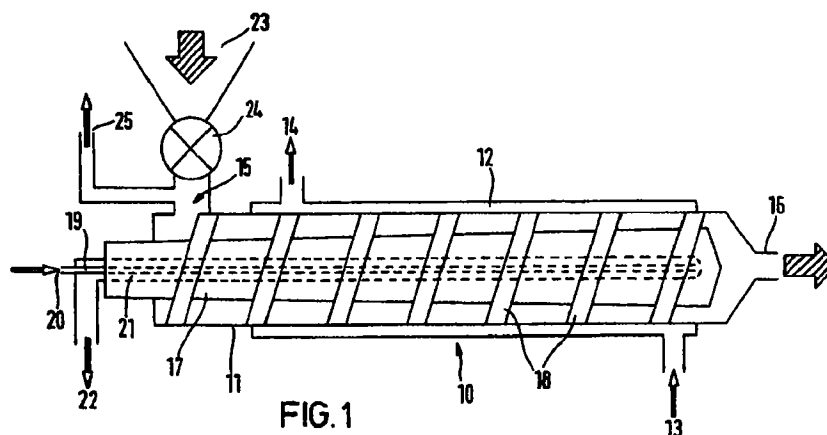
(72) Inventors:  
• **Jury, Mark**  
Thirsk, North Yorkshire YO7 2PH (GB)  
• **Mackley, Malcolm Robert**  
Crescent, Cambridge CB4 1AP (GB)  
• **Crook, Simon John**  
Exeter, Devon EX4 4AF (GB)

(74) Representative:  
**Pate, Frederick George et al**  
55, Avenue Nestlé  
1800 Vevey (CH)

**(54) Extrusion of chocolate**

(57) A process for plastically extruding a fat-containing confectionery material which comprises feeding the fat containing confectionery material into an extruder (11-12) and applying pressure to the fat-containing confectionery material in a substantially solid or semi-solid nonpourable form upstream of a flow constriction whereby the temperature, pressure, contraction ratio and extrusion rate are such that the fat-containing confectionery material is extruded and remains in a substantially solid or semi-solid nonpourable form to

produce an axially homogeneous extruded product having a cross section that is of substantially the same profile as the die exit (16) of the extruder, which is capable of retaining its shape and which has a temporary flexibility or plasticity enabling it to be physically manipulated, cut or plastically deformed before losing its flexibility or plasticity characterised in that a vacuum is applied to the fat-containing confectionery material upstream of the flow constriction.



**FIG. 1**

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Application Number  
EP 97 11 1239

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Place of search THE HAGUE		Date of completion of the search 5 October 1999	Examiner Guyon, R
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